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13. ABSTRACT (Maximum 200 words)

This grant provided two state-of-the-art vacuum facilities for seeded air plasma research on the AFOSR Grant F49620-97-0262 entitled "Laser and Radiofrequency Plasma Sources." Over \$24,000 in University matching funds were provided to acquire the equipment.

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Final Technical Report
Advanced Vacuum Equipment for Laser Plasma Research
AFOSR Grant AF-49620-97-1-0120, \$58,016
March 1 1997 – August 31, 1998

Professor J. Scharer, Principal Investigator
Electrical and Computer Engineering Department
University of Wisconsin
Madison, Wisconsin 53706

Abstract

This equipment grant was utilized to provide two state-of-the-art vacuum facilities for seeded air plasma research on the AFOSR Grant F49620-97-0262 entitled "Laser and Radiofrequency Plasma Sources." Over \$24,000 in University matching funds were provided to acquire the equipment. The laser plasma facility provided a first class vacuum facility with dry, chemically hardened, turbopump and mechanical pumps, vacuum windows and lenses for the ultraviolet laser, a residual gas analyzer and a vacuum spectrometer to diagnose the plasma. The radiofrequency vacuum facility provided a first class vacuum facility with dry, chemically hardened, turbopump and mechanical pumps, vacuum gauges, vacuum pipe and connections, a power supply for the magnetic field, and radiofrequency wave detection equipment. These two facilities are described and several of our journal publications during the past year were made possible by this equipment grant. A copy of the AFOSR annual report for last year is also attached and the research results obtained from the vacuum facilities are described. These facilities will provide an excellent basis for further contributions to the air plasma research program in the coming years.

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I. Summary of Laser Vacuum Facility Equipment Purchases

The following photo (Fig. 1) and laboratory figure (Fig. 2) shows the laser vacuum facility on which research is being carried out. Recent publications which have been obtained on the facility [1,2] are also noted. The equipment obtained allows us to provide a vacuum facility for seeded gas laser ionization experiments in air plasmas. The list of equipment obtained for the facility is as follows and is in essential agreement with the original proposal except that the dollar amounts and vendors have been slightly modified to reflect package purchases which were not available when the proposal was written.

Varian Vacuum Products	V550 Vacuum Turbo Cart. 8" CFF, 2 Baratron gauges; backed up by diaphragm pump with Kalrez seals, gate valve, CDG B/A hot filament gauge, 2.75" replacement gaskets	\$26,016.00
Pascal Technologies	Residual gas analyzer 300 AMU; Electron multiplier with high voltage power supply; Built-in Power Module for AC line operation; Replacement Thoriate d-Iridium Filament for RGA	5,339.43
Varian Vacuum Products	Vacuum ionization gauge including cables	1,236.80
MDC Vacuum Products	Vacuum flange adapter & SHV Connectors	425.00
Nor Cal Products	Vacuum Viewports and Tees	587.43
Federal Express	Shipping	110.00
	TOTAL:	\$33,714.66

The following items were purchased to complete the vacuum facility and provide laser lenses, vacuum windows, and a modest vacuum spectrometer to obtain diagnostic measurements of the laser formed plasma. They differ from the original proposal but complete the laser vacuum facility and make it operational for a more complete experimental facility.

CVI Laser Corp.	High Energy Laser Mirror; concave lens; convex lenses for transmission to Vacuum	\$4,426.27
GH Drysdale & Assoc.	ST2000, Ocean Optics, Triple Fiber Optic Vacuum Spectrometer	4,615.00
Omega Engineering	Omega hand-held Thermo Meter, Model HH-82; SM P KM Connectors; K-Type Omega Clad Thermocouple Wire	252.43
CVI Laser Corporation	Vacuum Laser Windows	404.41
	TOTAL:	\$9,698.11

II. Summary of Radiofrequency Vacuum Facility Equipment purchases

The following photo (Fig. 3) and laboratory figure (Fig. 4) illustrates the radiofrequency vacuum facility on which research is being carried out and a recent manuscript which has been obtained by use of the facility [3]. The equipment obtained allows us to provide a laser vacuum facility for seeded gas laser ionization experiments in air plasmas. The list of equipment obtained for the facility is as



Fig. 1. Laser Vacuum Facility (laser2.gif)

Air and TMAE Plasma Creation and Sustainment

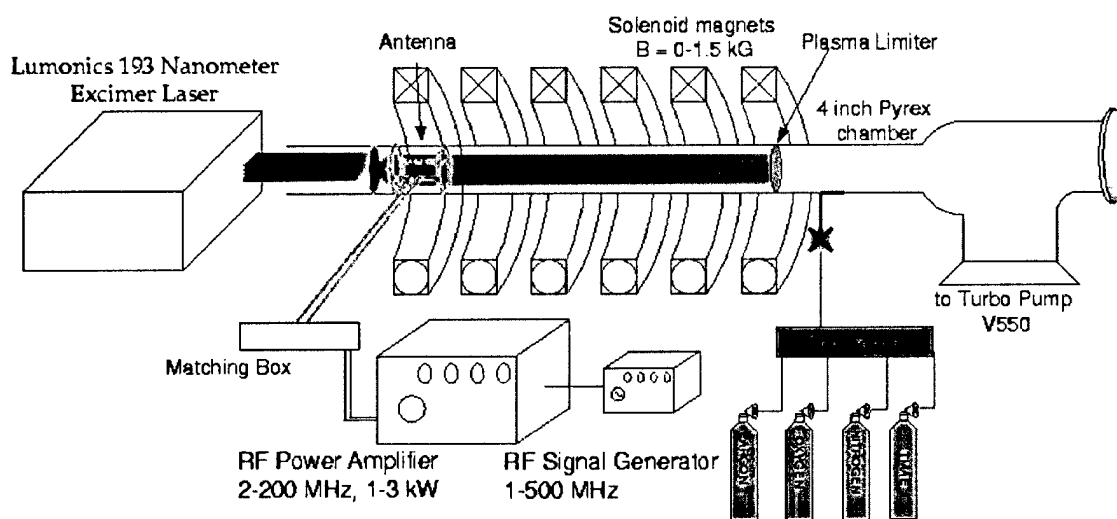


Fig. 2. Advanced Laser Vacuum Facility (Kurt's Prelim)

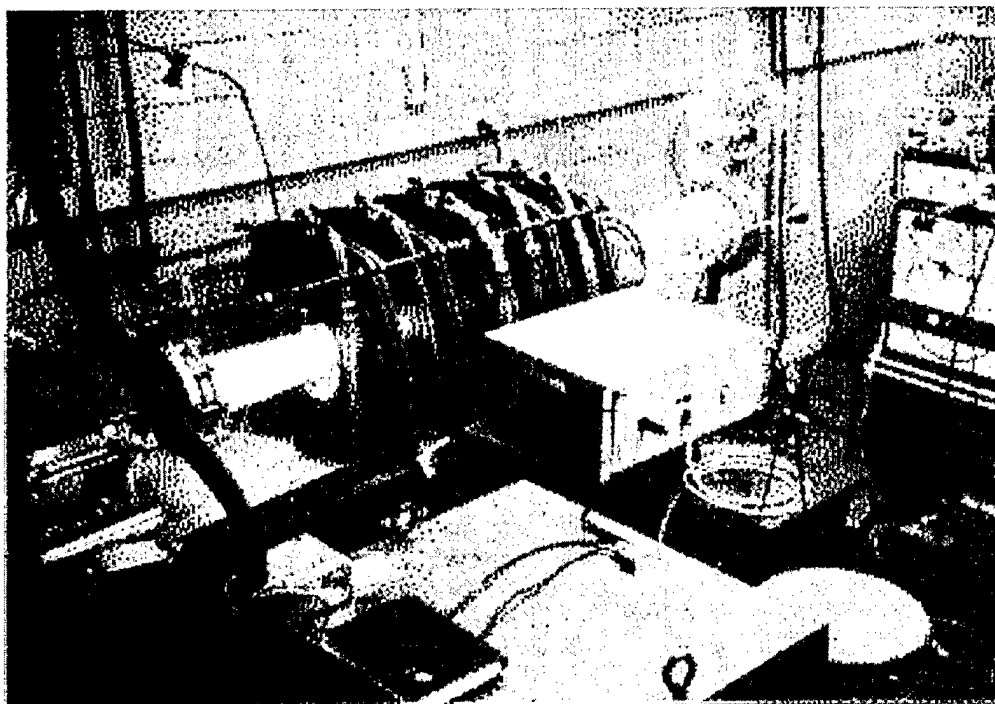


Fig. 3. Radiofrequency Advanced Vacuum Facility

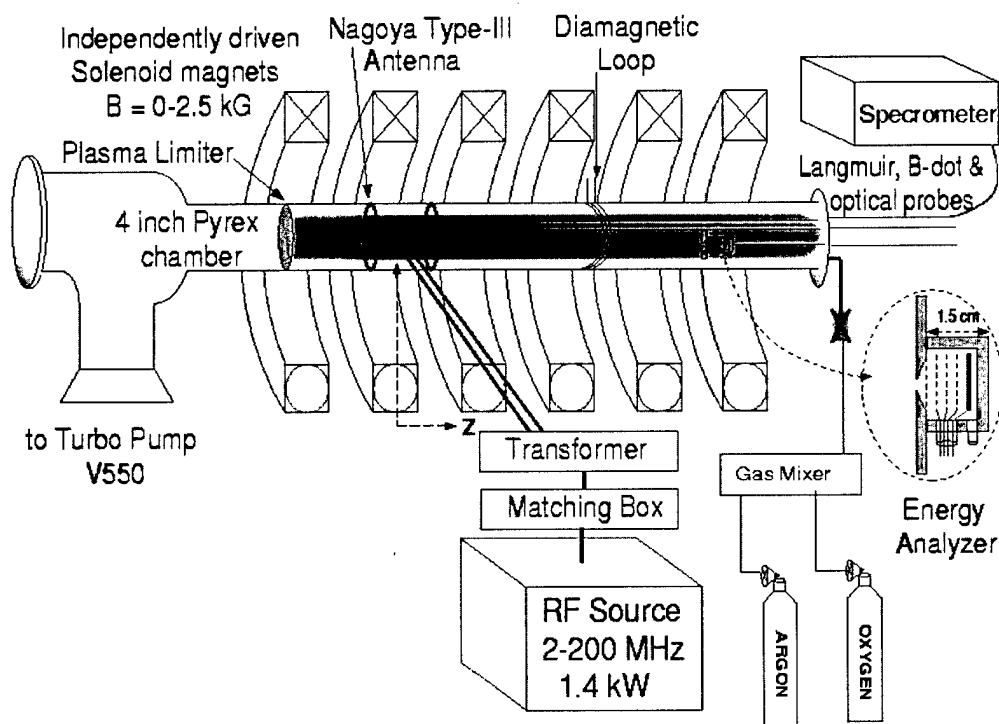


Fig. 4. Helicon experimental facility.

follows and is in essential agreement with the original proposal except that the dollar amounts and vendors have been slightly modified to reflect package purchases which were not available when the proposal was written.

Varian Vacuum Products	V550 Vacuum Turbo Cart, 8" CFF, 2 Baratron; backup by diaphragm pump with Kalrez seals, gate valve, GDG B/A hot filament gauge, 2.75" replacement copper gaskets; 362-4 Vacuum Cryotrap for VHS4/M; DP's 8" CF Inlet & Outlet	\$29,101.34
Varian Vacuum Products	Vacuum gaskets, nipples, flanges	406.70
Fred Hickey Corp.	Vacuum gaskets, flanges	1,422.04
Varian Vacuum Products	Vacuum copper gasket	51.40
Fred S. Hickey Corp.	Vacuum conical pipe, conical reducer tee, ACF flanges, gaskets, etc.	1,050.25
TOTAL:		\$32,031.73

The following items were purchased to complete the magnetized radiofrequency vacuum facility and provide diagnostic measurements of the radiofrequency formed plasma. They differ from the original proposal but complete the radiofrequency vacuum facility and make it operational for further air plasma experimental research.

Sorensen/Div. Of ELGAR	Magnet Power Supply: Sorensen Model PR055-180 T5M9C Regulator/Power Supply: 0-55 VDC, 0-180 Amps, 10 kW, 480 3-Phase VAC Input High Power, SCR Regulated DC Power Supply with GPIB, IEEE-488 Interface	\$5,798.53
Buckbee Mears St. Paul	Electroformed mesh transparencies	303.06
M-A Com	RF Double Balanced Mixer; 20 dB Bidirectional Couplers	588.00
TOTAL:		\$6,689.59

Total amount spent for above equipment	\$82,134.09
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Total AFOSR Grant	\$58,016.00
Total University of Wisconsin Matching Grant	24,118.09
TOTAL	\$82,134.09

III. Supplementary information

We have also attached large AFOSR stickers to larger parts of the equipment to reflect the source of this equipment funding, which is very much appreciated. A copy of the recent research progress report and the two research manuscripts are also enclosed for your information.

IV. References

- [1] G. Ding, J.E. Scharer, and K. L. Kelly, "Fast Langmuir Probe Measurements in a Laser Produced Plasma," *Journal of Applied Physics* 84, 1236-1241 (1998).
- [2] K. L. Kelly, J. E. Scharer, G. Ding, M. Bettenhausen and S. P. Kuo, "Microwave Reflections from a Vacuum Ultraviolet Laser Produced Plasma Sheet," *Journal of Applied Physics* 85 (1), 63-68 (1999).
- [3] X. Guo, J. E. Scharer, Y. Mouzouris and L. Louis, "Helicon Experiments and Simulations in a Nonuniform Magnetic Field," 32 pages, submitted to *Physics of Plasmas*, 1998.